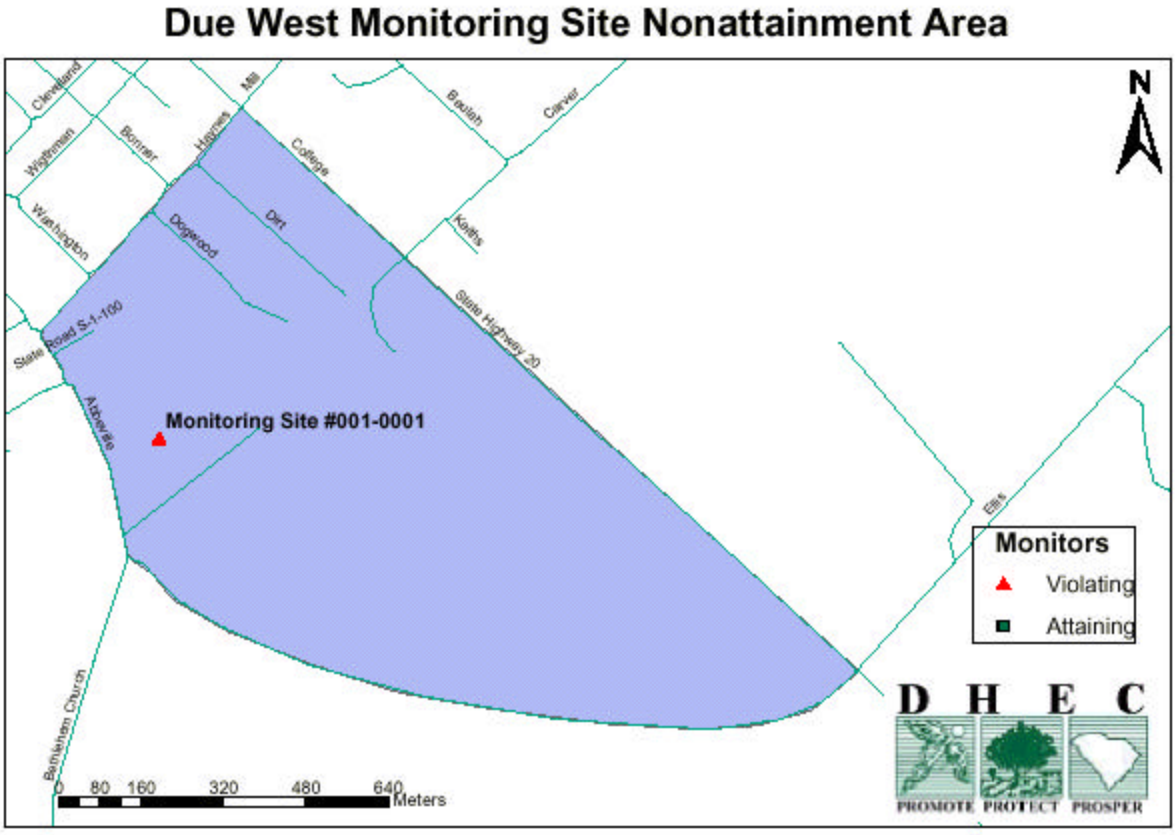


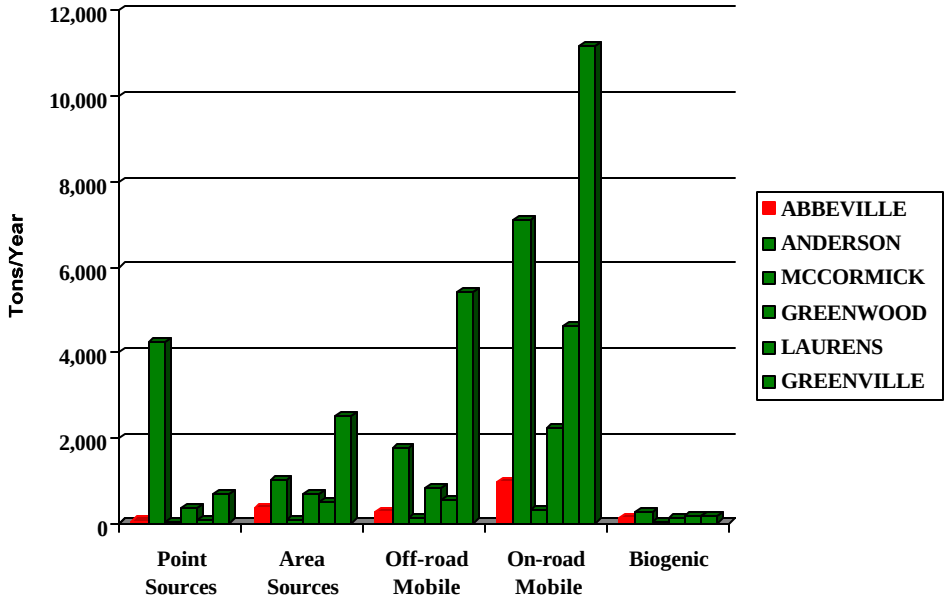
Figure 1: Due West Monitoring Site Nonattainment Area Map

The South Carolina Department of Health and Environmental Control (Department) recommends that the area encompassed by a boundary around the monitor site in Due West, Abbeville County, be designated a nonattainment area for the 8-hour ozone National Ambient Air Quality Standard (air quality standard) based on 2000 through 2002 monitoring data. This boundary is further described in Section I. The Department is also requesting that the United States Environmental Protection Agency (EPA) identify this area as a "rural transport area" in accordance with Section 182(h)(2) of the Clean Air Act (CAA), which states that the EPA may treat an ozone nonattainment area as a rural transport area if the Administrator finds that sources within the area do not make a significant contribution to the ozone concentrations measured in the area or in other areas. This recommended area will be referred to as the Due West Monitoring Site Nonattainment Area throughout the rest of this document.

Abbeville County is a rural county with a population in 2000 of 26,167. There are five (5) point sources accounting for 40 tons per year of NO_x and five (5) point sources accounting for 121 tons per year of VOCs in the county. Mobile source emissions are minor with 965 tons per year of NO_x and 625 tons per year of VOCs. As discussed later in this document, current meteorological information indicates that this area is influenced by transport from other areas. The monitor at Due West is marginally over the standard at 0.085 ppm and controls currently planned both regionally and nationally should lower the ozone concentrations at this location to below the standard. Therefore, a small boundary is recommended for nonattainment planning purposes. The Department is submitting this document to provide detailed information pertaining to the factors which EPA suggested be addressed in support of any nonattainment area designation recommendations.

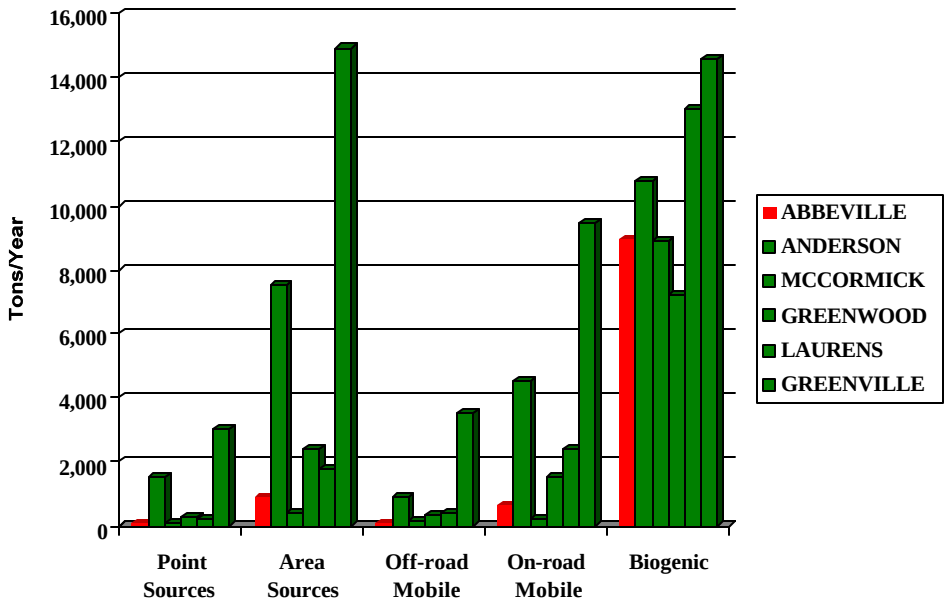
A. Emissions and Air Quality in Adjacent Areas (Including Adjacent MSAs)

Figure A-1: NOx Sources for Abbeville and Adjacent Counties*



*** Order of bars corresponds with order of counties in legend.**

Figure A-2: VOC Sources for Abbeville and Adjacent Counties*



*** Order of bars corresponds with order of counties in legend.**

To evaluate the emissions in Abbeville County and the adjacent areas, South Carolina utilized the estimated annual 1999 oxides of nitrogen (NO_x) and volatile organic compounds (VOC) emissions. The types of NO_x and VOC emission sources that were evaluated include point, area, biogenic, and on-road and off-road mobile sources. Figures A-1 and A-2 show the percentage of emissions from each source category for Greenville County and surrounding South Carolina Counties. Additional emissions inventory information is provided in Section D.

Abbeville County is not part of a Metropolitan Statistical Area (MSA). Air quality information is provided in Section C.

B. Population Density and Degree of Urbanization Including Commercial Development (Significant Difference from Surrounding Areas)

According to the US Census, urban is defined as all territory, population, and housing units in urbanized areas and urban clusters. An urbanized area is defined as a densely settled area that has a census population of at least 50,000, and an urban cluster is defined as a densely settled area that has a census population of 2,500 to 49,999. An urban area is a generic term that refers to both urbanized areas and urban clusters. Rural is defined as all territory, population, and housing units located outside of urbanized areas and urban clusters.

Based on these definitions, Abbeville County would be considered rural. Abbeville County is 508 square miles and had a population of 26,167 in 2000. The current population density is 51.5 persons per square mile and only 23.4 percent of the county's population, or 6,130 people live inside of urban clusters located in the town of Abbeville.

The recommended area covers a portion of the town of Due West, which has a population of 1,182 people. Assuming that the Due West Monitoring Site Nonattainment Area contains 20% of the population of Due West relative to the town limits and that the population of Due West is evenly distributed, the recommended nonattainment area is estimated to contain approximately 236 people. The Due West Monitoring Site Nonattainment Area is calculated to be 4.6 square miles.

Table B-1 contains population data for both Abbeville County and the recommended Due West Monitoring Site Nonattainment Area.

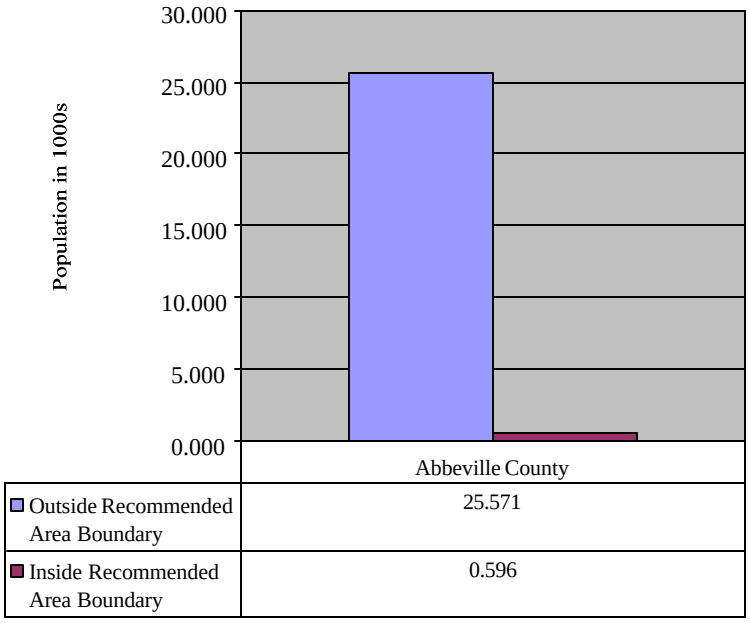
Table B-1:
Total Population, Land Area, and Urban/Rural Population, 2000

	Abbeville County	Recommended Area
Population[1]	26,167	236*
Land Area (Square Miles)[1]	508	4.6*
Persons per Square Mile[1]	51.5	51.5*
Urban Population[2]	6,130	236*
% Urban Population[2]	23.4%	0.0%
Rural Population[2]	20,037	296

[1] Data provided by US Census: 2000. Portions of the data for the recommended area were obtained from the SCDOT.
[2] Data provided by SC Office of Research and Statistics.

	Table B-1: Total Population, Land Area, and Urban/Rural Population, 2000	
	Abbeville County	Recommended Area
% Rural Population [2]	76.6%	100.0%
* The data for the recommended area is based on assumptions and is only estimates. The actual data may be greater than or less than the data provided.		

Figure B-1: Population Distribution Relative to recommended Area Boundaries, 2000



Being predominantly rural, Abbeville County has various industry and businesses located throughout the county, but the largest business type in the county is manufacturing. In fact, manufacturing accounts for about 61.5 percent of the workforce in the county, although manufacturing establishments only total 38 establishments, or just over 11 percent of the county businesses. Retail trade is the second largest county employer as 541 persons work at some 64 retail businesses throughout the county. The unemployment rate for Abbeville County for 2002 was 8.7%.[3] The town of Abbeville, which is approximately less than 20 miles from the Due West monitoring site, appears to contain the majority - both employees and establishments - of the manufacturing and other business in the county. No manufacturing establishments, and hence no manufacturing employees, are located in the town of Due West or the recommended area, although there may be some retail trade establishments and employees in the recommended area.

C. Monitoring Data Representing Ozone Concentrations in Local Areas and Larger Areas (urban or regional scale)

[3] Data provided by the SC Employment Security Commission.

The Due West Monitoring Site Nonattainment Area Map (Figure 1) shows the ozone monitoring station in the Due West Monitoring Site Nonattainment Area. The Due West (45-001-0001) air-monitoring site is located in Abbeville County near the Dixie High School football field. The area surrounding the monitoring site is agricultural and it sits approximately 204 meters above sea level. The site has been in operation since 1991 and measurement of ozone concentrations occurs mid-March through mid-November. The monitoring objective for Due West site is to measure ozone concentrations for general background.

Table C-1 presents the 2000 through 2002 8-hour ozone monitoring data for Abbeville County. The design value is the annual fourth-highest daily maximum 8-hour ozone concentration, expressed in parts per million (ppm), averaged over three consecutive years. Since the 2002 ozone design value for the Due West monitoring site is 0.085 ppm, the site is marginally exceeding the 8-hour ozone standard.

Table C-1:
Due West Ozone Monitoring Data

County	Site ID	Site Name	4th Maximum 8-Hour			Design Value
			2000	2001	2002	
Abbeville	45-001-0001	Due West	0.085	0.082	0.088	0.085

Table C-2 contains the 2000 through 2002 daily maximum ozone concentrations above 0.084 ppm for the Due West monitoring site. The shaded box indicates the fourth-highest daily maximum 8-hour ozone concentration.

Table C-2:
Due West Site, Abbeville County

Year	Date of Exceedance	8-hour Average (ppm)
2000	06/02/2000	0.089
	08/09/2000	0.089
	06/01/2000	0.086
	05/19/2000	0.085
2001	05/18/2001	0.091
2002	06/13/2002	0.102
	09/10/2002	0.09
	07/06/2002	0.088
	09/05/2002	0.088
	09/11/2002	0.088
	07/05/2002	0.086

Table C-2: Due West Site, Abbeville County		
Year	Date of Exceedance	8-hour Average (ppm)
	08/08/2002	0.086
	08/21/2002	0.086
	06/18/2002	0.085
	07/17/2002	0.085

For the period from 2000 to 2002, only 16 of the 642 readings on the daily maximum 8-hour ozone average are greater than 0.084 ppm. If the projected annual fourth maximum 8-hour ozone average is less than or equal to 0.084 ppm in 2003, then the design value will be below the air quality standard. The Department requests that formal designations use the most current data available. As NO_x emissions are reduced at the national, regional, and urban area levels, it is expected that lower ozone levels will occur in this area.

D. Location of Emission Sources

Table D-1 lists the NO_x point sources that are in operation in Abbeville County based on the 1999 NO_x and VOC emissions inventory i-Steps data. The county has 5 NO_x point sources in operation. Abbeville County's NO_x point source emissions are 40.39 tons/year. There are not any point source emissions of NO_x in the Due West Monitoring Site Nonattainment Area.

Table D-1: Abbeville County Point Source NO2 Emissions

County	Plant Name	Permit Number	Pollutant	Point Source-NO2 (Tons Per Year)
Abbeville	Dura-Vent	0040-0013	NO2	0.06
Abbeville	Milliken:Abbeville	0040-0005	NO2	15.90
Abbeville	Mohawk:Calhoun Falls	0040-0001	NO2	16.43
Abbeville	Pirelli Power Cable:Abbeville	0040-0017	NO2	1.96
Abbeville	West Point Stevens:Calhoun	0040-0003	NO2	6.04
	1999 Abbeville Co Total			**40.39**
	Emissions in Nonattainment Area-Total			**0.00**
	Emissions in Nonattainment Area-Percent			**0.0%**

Table D-2 lists the VOC point sources that are in operation in Abbeville County based on the 1999 NO_x and VOC emissions inventory i-Steps data. The county has 5 VOC point sources in operation. Abbeville County's VOC point source emissions are 120.86 tons/year. There are not any point source emissions of VOC in the Due West Monitoring Site Nonattainment Area.

Table D-2: Abbeville County Point Source VOC Emissions				
County	**Plant Name**	**Permit Number**	**Pollutant**	**Point Source-VOC (Tons Per Year)**
Abbeville	Dura-Vent	0040-0013	VOC	43.48
Abbeville	Milliken:Abbeville	0040-0005	VOC	11.33
Abbeville	Mohawk:Calhoun Falls	0040-0001	VOC	1.79
Abbeville	Pirelli Power Cable:Abbeville	0040-0017	VOC	58.08
Abbeville	West Point Stevens:Calhoun	0040-0003	VOC	6.18
	1999 Abbeville Co Total			**120.86**
	Emissions in Nonattainment Area-Total			**0.00**
	Emissions in Nonattainment Area-Percent			**0.0%**

Table D-3 lists the NO_x on-road emissions for Abbeville County.

Table D-3: Abbeville County On-road NO_x Emissions			
County	**Tier 1**	**Tier 2**	**Highway NO_x (Tons Per Year)**
Abbeville	11-Highway Vehicles	01-Light-Duty Gas Vehicles & Motorcycles	298.00
Abbeville	11-Highway Vehicles	02-Light-Duty Gas Trucks	171.00
Abbeville	11-Highway Vehicles	03-Heavy-Duty Gas Vehicles	49.00
Abbeville	11-Highway Vehicles	04-Diesels	447.00
	1999 Abbeville Co Total		**965.00**

Table D-4 lists the VOC on-road emissions.

Table D-4: Abbeville County On-road VOC Emissions			
County	**Tier 1**	**Tier 2**	**Highway VOC (Tons Per Year)**
Abbeville	11-Highway Vehicles	01-Light-Duty Gas Vehicles & Motorcycles	343.00
Abbeville	11-Highway Vehicles	02-Light-Duty Gas Trucks	201.00
Abbeville	11-Highway Vehicles	03-Heavy-Duty Gas Vehicles	49.00
Abbeville	11-Highway Vehicles	04-Diesels	32.00
	1999 Abbeville Co Total		**625.00**

E. Traffic and Commuting Patterns

Estimates of the Daily Vehicle Miles Traveled (DVMT) were obtained from the South Carolina Department of Transportation (SCDOT). SCDOT determines current DVMT by multiplying traffic volume (through traffic counts) and lane miles (determined by the Highway Performance Monitoring System) for each particular area. The South Carolina Department of Public Safety, Division of Motor Vehicles, provided motor vehicle registration data. All other data in this section was obtained from the US Census Bureau. All data is based on the year 2000.

Table E-1[4] presents the breakdown by road classifications of DVMT traveled in Abbeville County from 2000 and projected through 2025. Abbeville County only had 578,094 DVMT in 2002 and is projected to have 789,900 DVMT for 2025.

	Table E-1: DVMT Data for Abbeville County			
	2000	**Projected 2007**	**Projected 2012**	**Projected 2025**
Abbeville County				
Rural Interstate (01)	-	-	-	-
Rural Principal Arterial (02)	137,955	152,107	162,216	188,499
Rural Minor Arterial (03)	159,381	175,731	187,410	217,775
Rural Major Collector (04)	83,796	92,392	98,533	114,498
Rural Minor Collector (05)	20,102	22,164	23,637	27,467
Rural Local (09)	93,022	102,565	109,381	127,104
Rural Total	*494,255*	*544,960*	*581,177*	*675,343*
Urban Interstate (11)	-	-	-	-
Urban Freeway/Expressway (12)	-	-	-	-
Urban Principal Arterial (13)	30,911	34,082	36,347	42,236
Urban Minor Arterial (14)	21,683	23,907	25,496	29,627
Urban Collector (15)	18,353	20,236	21,581	25,077
Urban Local (18)	12,892	14,214	15,159	17,615
Urban Total	*83,839*	*92,440*	*98,583*	*114,556*
Grand Total DVMT	**578,094**	**637,399**	**679,761**	**789,900**

Table E-2[5] presents the 2000 worker flow data from each of the counties. Some counties that are listed on this table are not being considered for boundary recommendations and are being included on this chart to account for all workers in each county. This table shows that approximately 52% of workers that live in Abbeville County work inside the county. Of the residents that work outside of Abbeville County, approximately 74% commute to the neighboring Counties of Greenwood or Anderson.

	Table E-2: Where People Work Who Live in SC		
	County of Residence		
County Worked In	Abbeville	Out of State	Grand Total
Grand Total	11,334	162	11,496
Abbeville	5,898	162	6,060
Aiken	15		15
Anderson	1,762		1,762
Berkeley	6		6
Edgefield	25		25
Florence	6		6
Greenville	527		527
Greenwood	2,271		2,271

[4] Data provided by SCDOT.
[5] Data provided by US Census: 2000.

	Table E-2: Where People Work Who Live in SC		
	County of Residence		
Laurens	147		147
Lexington	5		5
McCormick	123		123
Oconee	32		32
Out of State	345		345
Pickens	85		85
Richland	33		33
Spartanburg	45		45
Union	9		9

Figure E-1:
Urban vs. Rural DVMT for Abbeville County

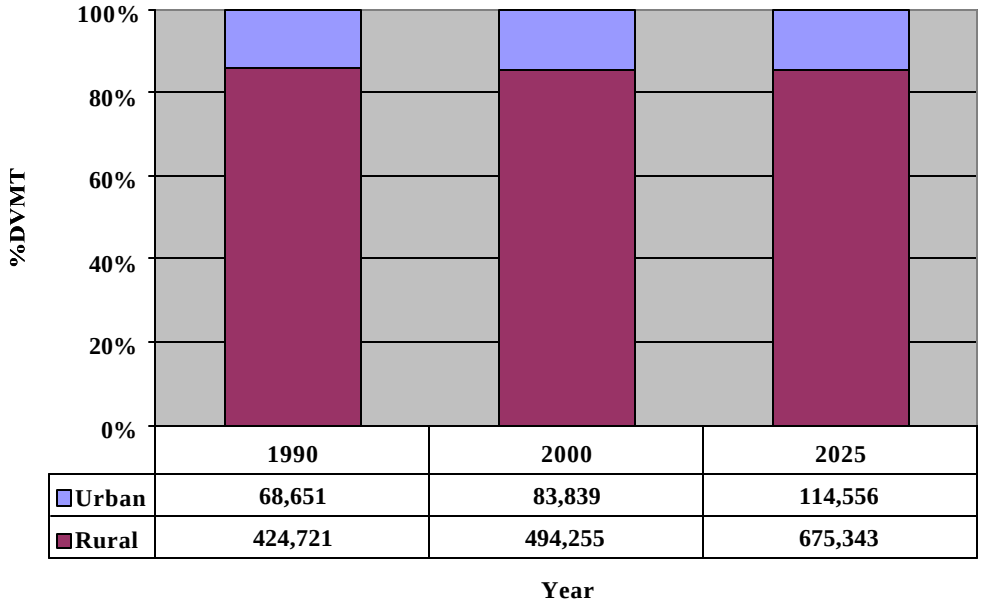


Figure E-1[6] presents the Urban and Rural DVMT comparison for Abbeville County. Note that only about 10-15% of the DVMT in Abbeville County is traveled on urban roads. This shows that there are few roads in Abbeville County that support large traffic volumes, and further supports the rural transport recommendation.

[6] Data provided by US Census: 2000.

Figure E-2:
2000 Motor Vehicle Registration for Abbeville County

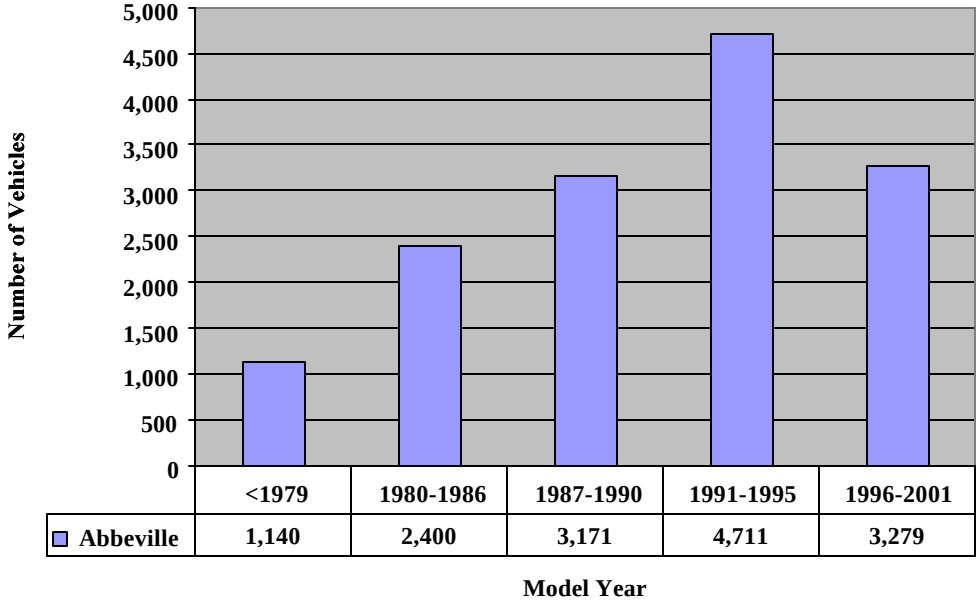


Figure E-2[7] presents the motor vehicle registration data for Anderson and Abbeville Counties. Only a small portion of the vehicles are pre-1981 model years. In 1981 new cars were outfitted with three-way catalysts, on-board computers, and oxygen sensors to help increase the efficiency of the catalytic converters. This figure shows that the majority of cars registered are model years 1991-1995. In 1991 the EPA established lower tailpipe standards for hydrocarbons and nitrogen oxides beginning with 1994 model year vehicles.

This data reflects 2000 registration figures, and many of the older vehicles will probably have been replaced with newer vehicles. These vehicle turnovers, combined with future national low sulfur fuel standards, the use of Onboard Diagnostic (OBD) systems, and Onboard Refueling Vapor Recovery (ORVR) systems will help to offset any potential impacts from the increased emissions from mobile sources in this area.

F. Expected Growth (Including Extent, Pattern, and Rate of Growth)

Limited data is available in assessing expected growth for Abbeville County. No known data is available for accurately assessing growth for the recommended area. Conclusions were drawn based on historical data from 1990, current data from 2000, and population projections for 2020 as contained in Table F-1. Economic growth, relative to population growth, is even harder to predict. No knowledge of major economic expansions is available. While it is certain that population counts will grow, it is only assumed that current economic factors will remain stable or that some economic growth will occur.

[7] Data provided from SC Department of Public Safety, Division of Motor Vehicles.

Table F-1: Historical and Projected Population and Population Density	
	Abbeville County
Population, 1990[8]	23,862
Population, 2000[9]	26,167
Projected Population, 2020[10]	29,350
Population. Growth Rate, 1990 – 2000 (Persons per 5 Years)	1152.5
Projected Population Growth Rate, 2000 - 2020 (Persons per 5 Years)	795.8
Land Area (Sq. Miles)	508
Persons per Sq. Mile, 2000	51.5
Projected Persons per Sq. Mile, 2020	57.8
Urban Population, 2000	6,130
% Urban Population, 2000	23.4%
Rural Population, 2000	20,037
% Rural Population, 2000	76.7%

The largest employment sector in the county is manufacturing.[11] The second and third largest sectors are health care and social assistance and retail trade, respectively.

G. Meteorology

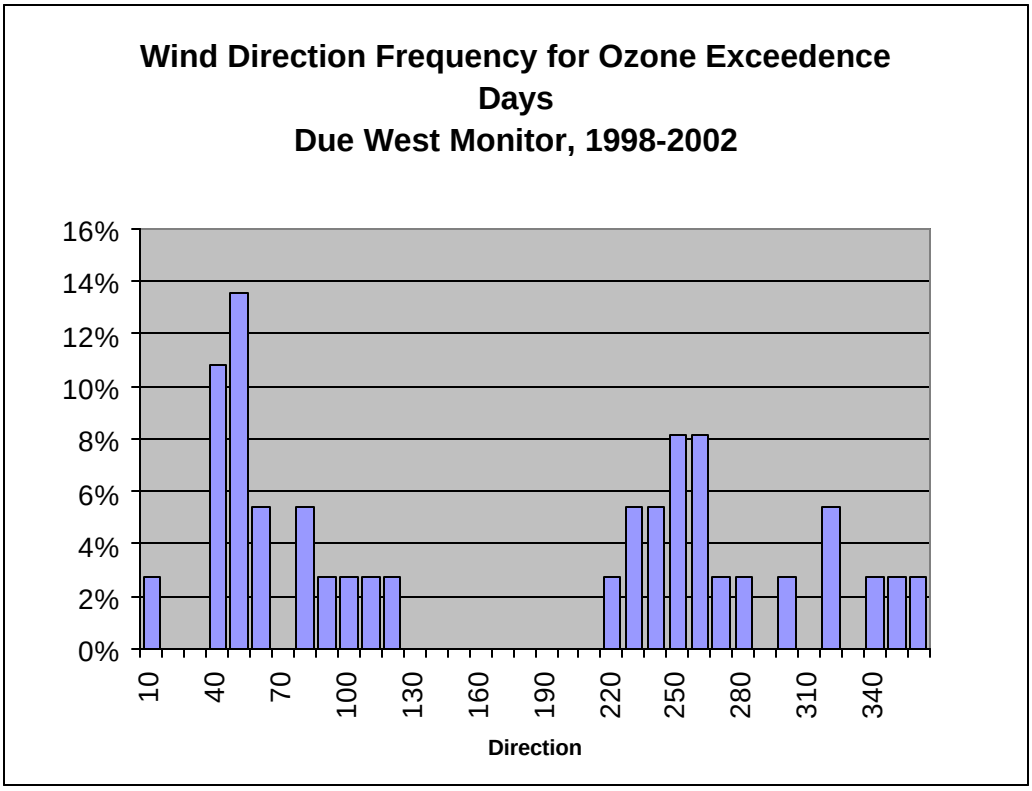
I. Introduction

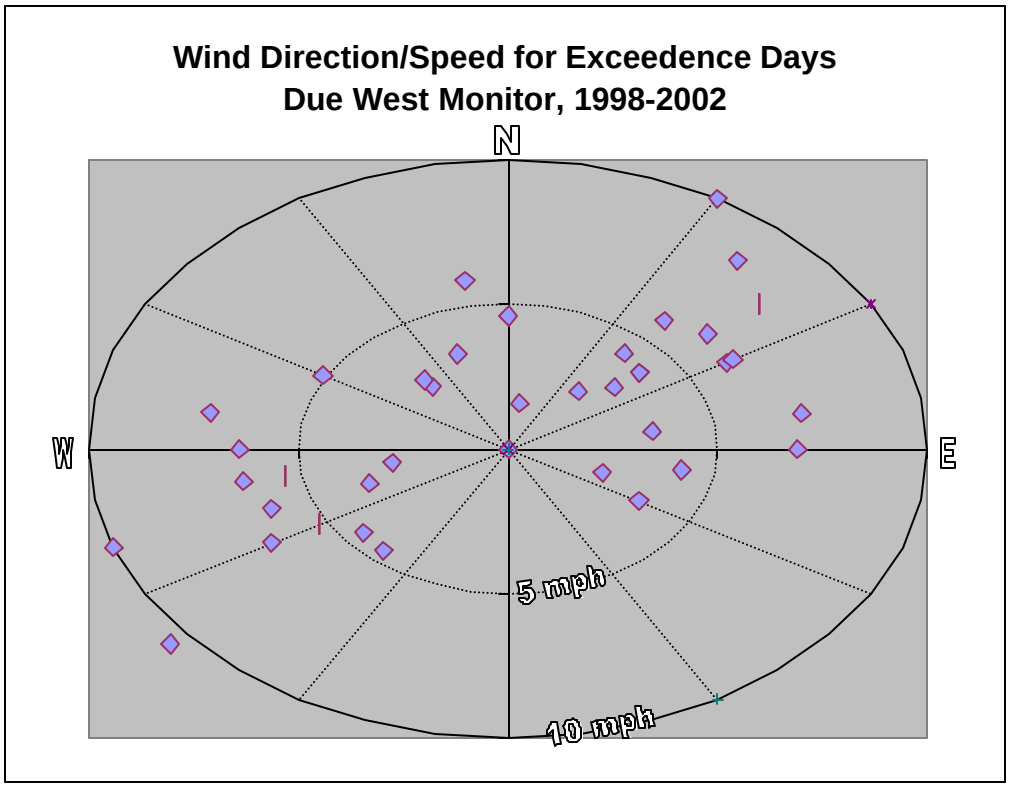
Meteorological conditions play an important role in sourcing precursory pollutants essential to the formation of ozone across a monitored geographical area. This is especially true for largely rural Abbeville County, an area devoid of significant sources of NO_x and VOC. Thus, peak concentrations of ground-level ozone measured at the Due West monitor, the sole monitoring site in Abbeville County, are determinant on the magnitude of upwind sourcing and high ozone events (8-hour peak ozone concentrations of 85 parts per billion (ppb) or more) which occur when high concentrations of pollutants from outside the local area are transported to the Due West vicinity by the ambient wind.

This dependence on upwind sourcing for high ozone events is evidenced by the distribution of surface wind directions during the 37 ozone "exceedence days" (8-hour peak concentration of 85 ppb or more) as measured at the Due West monitor during the 1998-2002 period (Figures G-1 and G-2). As shown in Figure G-1, the most frequent wind directions (24-hour average measured at the Greenville-Spartanburg Airport) during these episodes were northeasterly and west-southwesterly, while no winds were measured from the southeast through south-southwest sector. This same pattern is illustrated in the "wind rose" type graph in Figure G-2 in which each plotted point indicates the wind direction and speed for each of the 37 exceedence days. Wind directions from the northeast and west-southwest place the Due West monitor directly downwind of the Charlotte and Atlanta metropolitan areas, respectively. Conversely, there are no major metropolitan areas located in the southeast through south-southwest quadrant from Due West. Therefore, these data indicate on a broad scale that high ozone events at Due West occur most frequently when upwind sourcing is from high population urban areas.

[8] Data provided by US Census: 2000.
[9] Data provided by US Census: 2000.
[10] Data provided by EPA.
[11] Data provided by US Census: 2000.

Figures G-1 and G-2





To better illustrate the relationship between wind (speed, direction, and duration) and transport of ozone precursors into the Due West area, two representative high-ozone events were evaluated using meteorological data from the National Oceanic & Atmospheric Association's air resource lab website, namely near-surface (1000 mb) streamline analyses and low-level air back-trajectories. These analyses were compared with ozone concentration maps from EPA's AirNow mapping system to show the relationship between the wind field, patterns of regional ozone concentration, and peak ozone levels observed at the Due West monitor during these periods. The results of these evaluations confirm transport as the major reason for such high ozone levels at a monitoring site in such a sparsely populated and lightly industrialized county.

II. Example Event #1

The first "event" evaluated occurred from June 12-13, 2002, where levels by the afternoon hours on the 13 ultimately reached 102 ppb at the monitoring site. The genesis of the event occurred as many as 48 hours earlier on the afternoon of June 11, where levels over the Atlanta Metro area reached above 105 ppb (the "Red" category) for the second of three consecutive days (Figure G-3). In contrast, the Abbeville monitor barely reached the "Yellow" category, with an 8-hr peak near 80 ppb that same afternoon (Figure G-3). Streamline analysis over the 12-hour overnight period (8pm 6/12 through 8am 6/13) (Figures G-4 through G-6) noted a very light (or less than 5 mph) westerly wind that eventually "recirculated" (became southerly then easterly) for a few hours between 8pm and midnight. By daybreak on the 13 (Figures G-7 & G-8) these winds, which had pushed the air mass back over its source areas from the day before, began flowing lightly back to the east towards the SC border. This now southwesterly flow became persistent throughout the morning and afternoon hours (Figures G-9 through G-12), transporting pollutants across a wide swath of the Piedmonts of Georgia, South Carolina, and ultimately, North Carolina (Figure G-14). Tracing the trajectory of the wind through the air mass back 24 hours (Figure G-13), elevated ozone across Abbeville County, and in fact the entire region, appears to follow a markedly precise vector back from northern Georgia.

Fig. G-3: 8-hour Average Peak Concentration on June 11th and June 12th, 2002

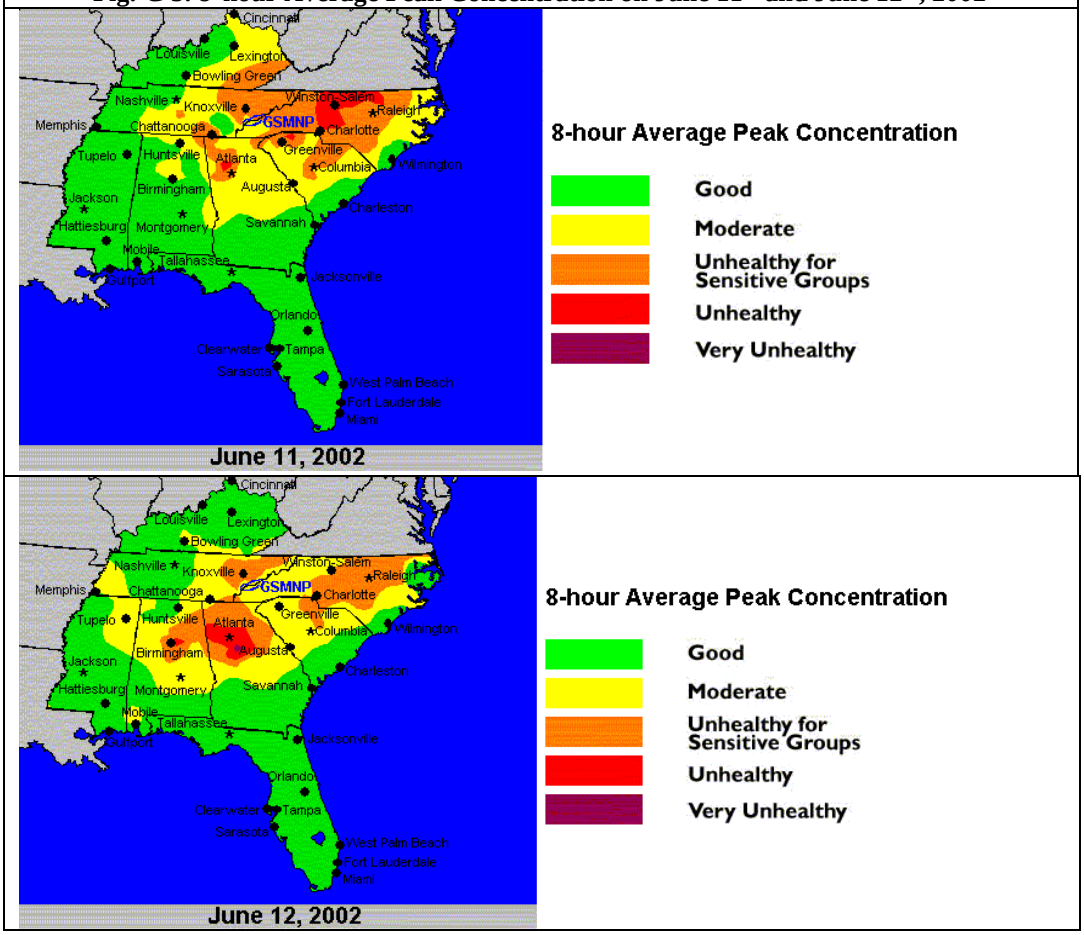


Fig. G-4: 1000mb Streamlines on June 12, 2002 at 8:00 pm

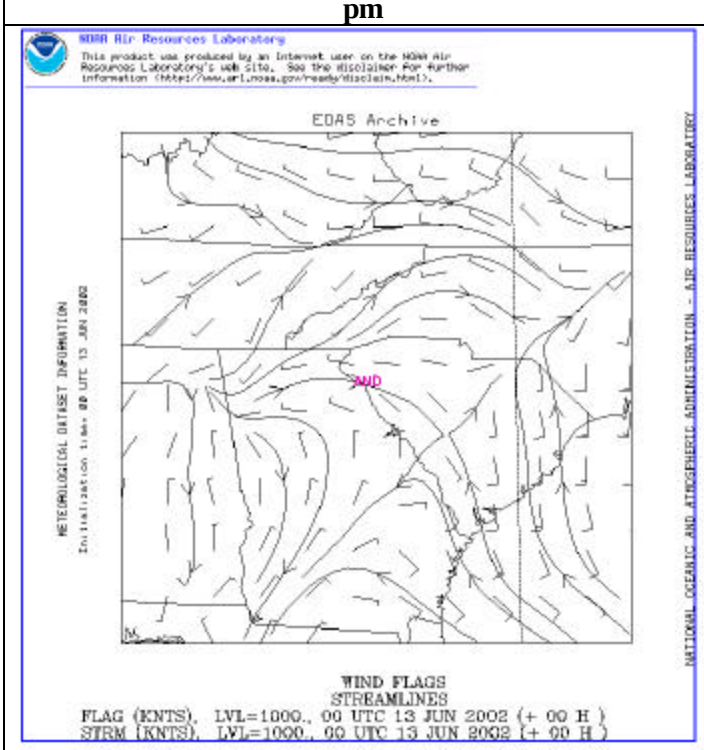


Fig. G-5: 1000mb Streamlines on June 12, 2002 at 11:00 pm

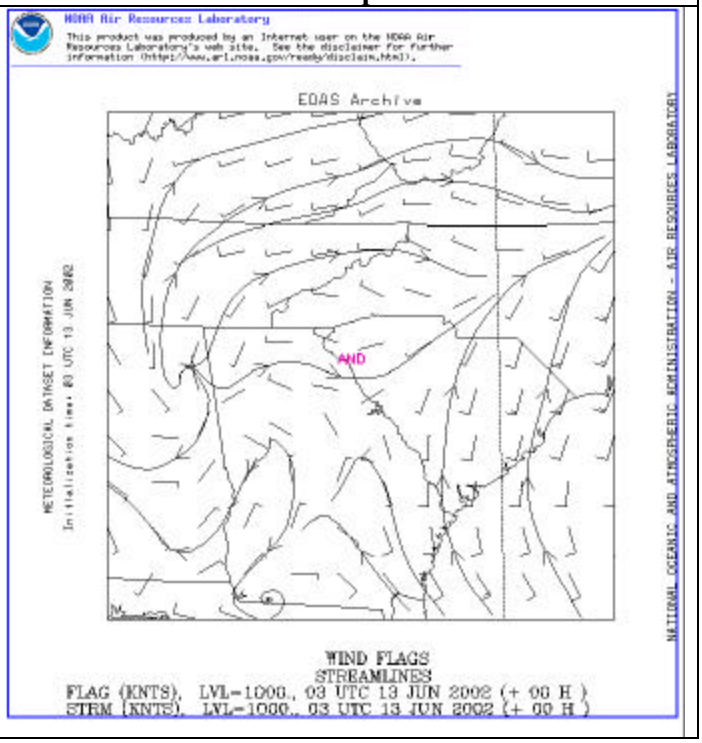


Fig. G-6: 1000mb Streamlines on June 13, 2002 at 2:00 am

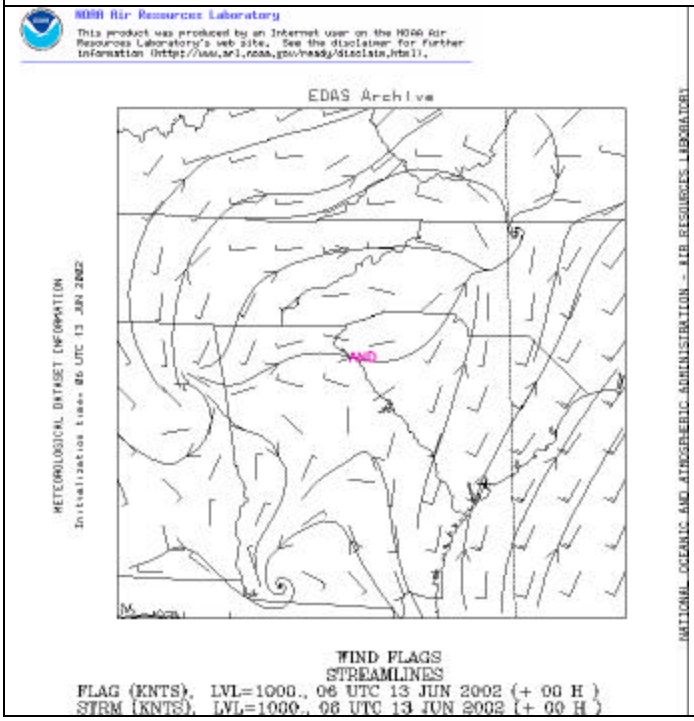


Fig. G-7: 1000mb Streamlines on June 13, 2002 at 5:00 am

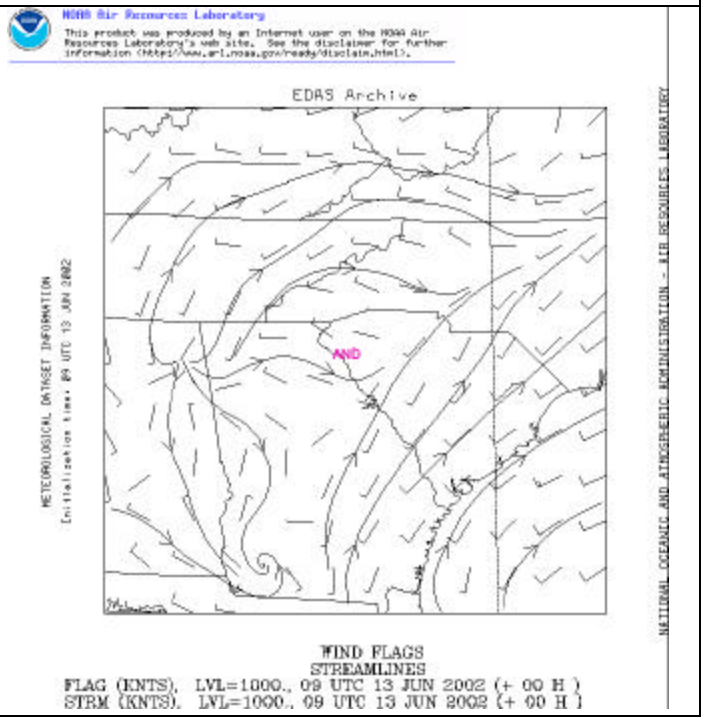


Fig. G-8: 1000mb Streamlines on June 13, 2002 at 8:00 am

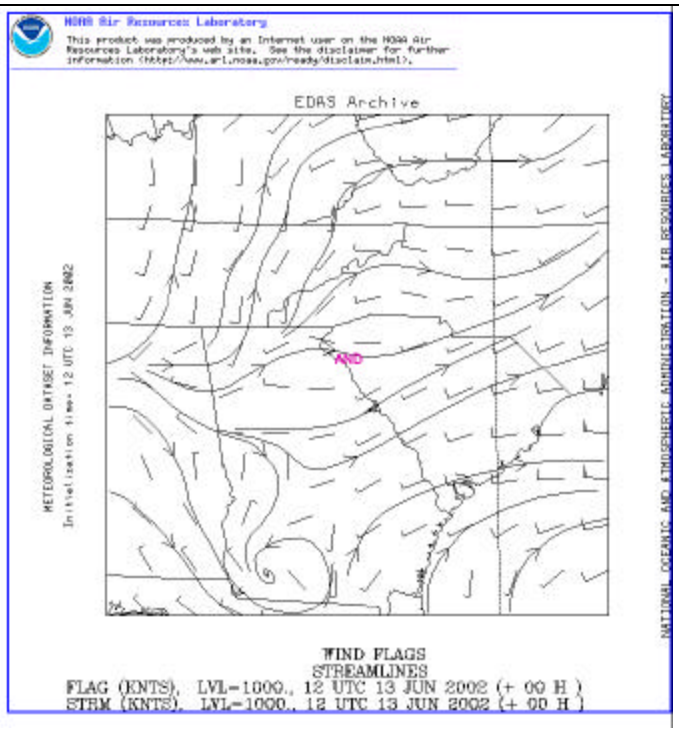


Fig. G-9: 1000mb Streamlines on June 13, 2002 at 11:00 am

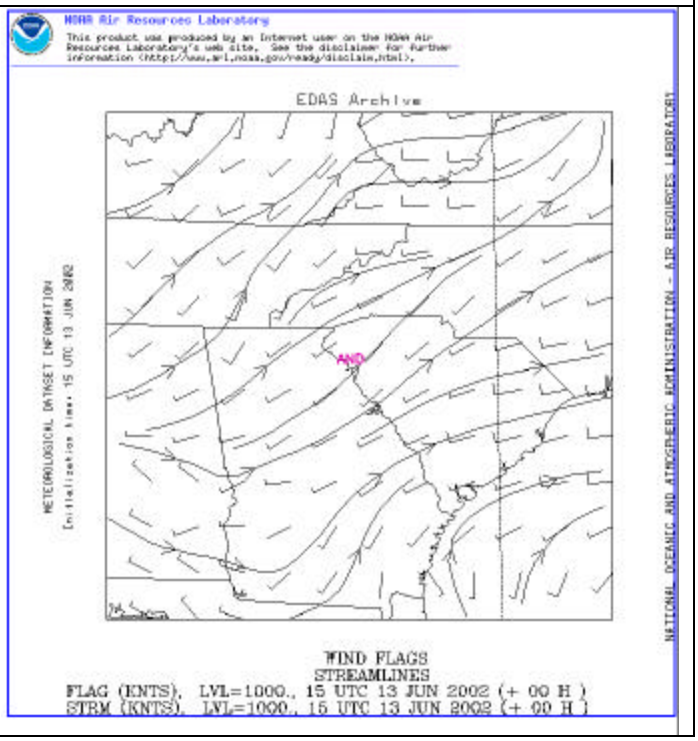


Fig. G-10: 1000mb Streamlines on June 13, 2002 at 2:00 pm

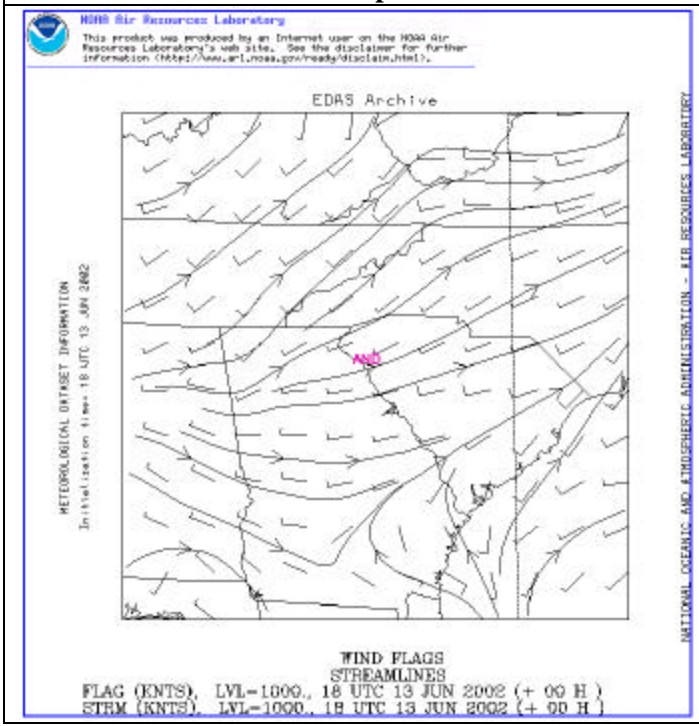


Fig. G-11: 1000mb Streamlines on June 13, 2002 at 5:00 pm

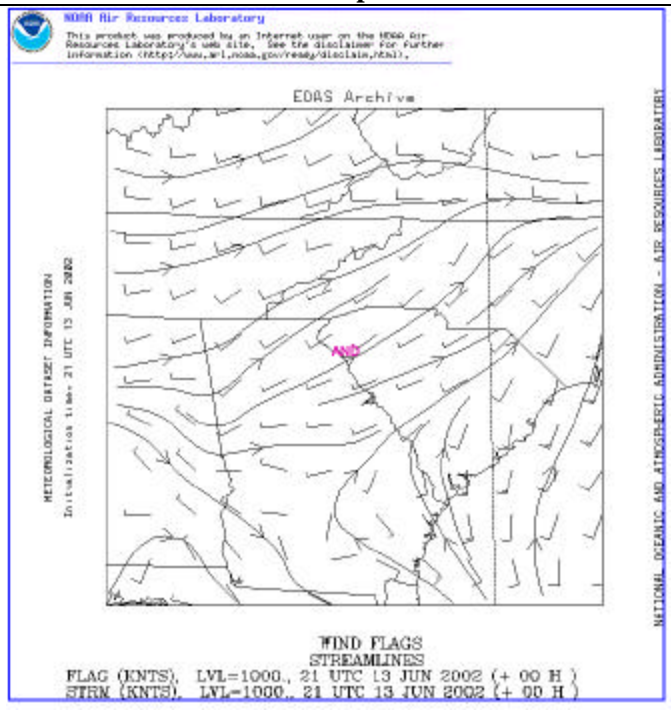


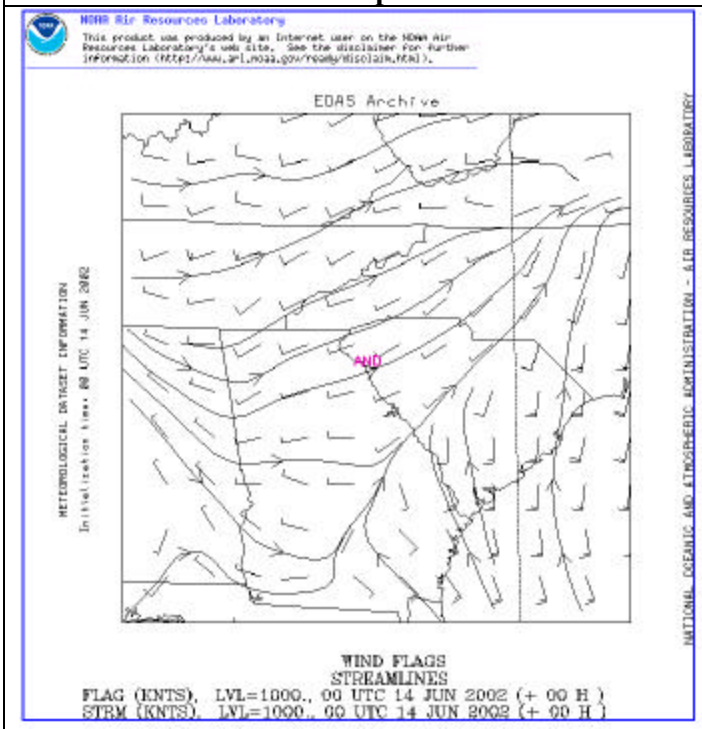
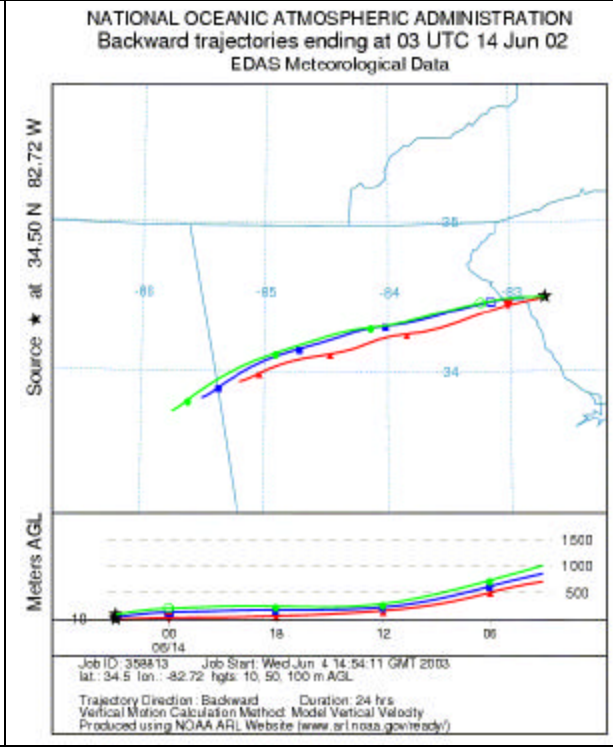
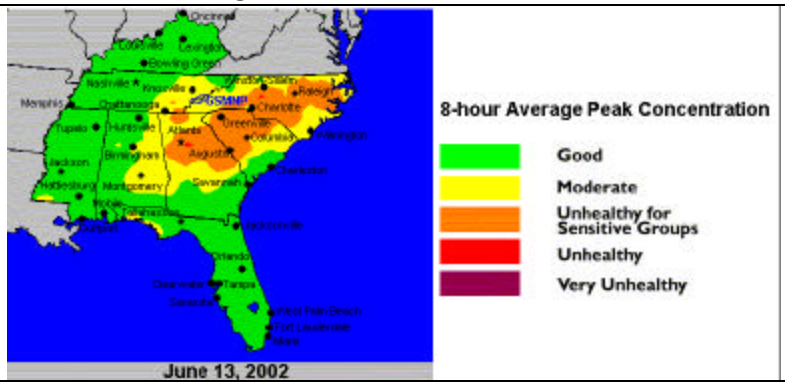
Fig. G-12: 1000mb Streamlines on June 13, 2002 at 8:00 pm	Fig. G-13: 24-hr Back-trajectory, 11pm, June 13th, 2002
	

Fig. G-14: 8-hour Average Peak Concentration on June 13, 2003


III. Example Event #2

To contrast the initial analysis, a second "event", which occurred from July 5-6, 2002, was evaluated. This event was selected as an example of sourcing from large metropolitan areas to the northeast that significantly increased ozone concentrations over the Due West site. Streamline analyses throughout the period (Figs. G-15 through G-23) show an elongated trof extending from the Gulf though the Atlantic Coastal areas. A significant cyclonic eddy developed along the trof in southern Georgia, moving slowly throughout the period along its axis into the Lowcountry of South Carolina (Figs. G-19 through G-22). Winds were fairly light from a general northerly direction in the zone of subsiding air on the northwestern

side of this feature. This brought pollutants from recent stagnation over the Mid-Atlantic region into North Carolina and, ultimately, the Upstate of South Carolina, including the Due West area (Fig. G-25). Once again, back-trajectory tracings demonstrate the source region for this period to be geographically far from the Abbeville area (Fig. G-24). Thus, as was the case of the previous evaluation, transport was shown as the main reason for levels exceeding the 8-hr standard at Due West on the 5 and 6.

Figs. G-15 thru G-23
1000mb Streamline analyses
July 4th, 2002 at 8:00pm through July 6th, 2002 at 8:00pm.

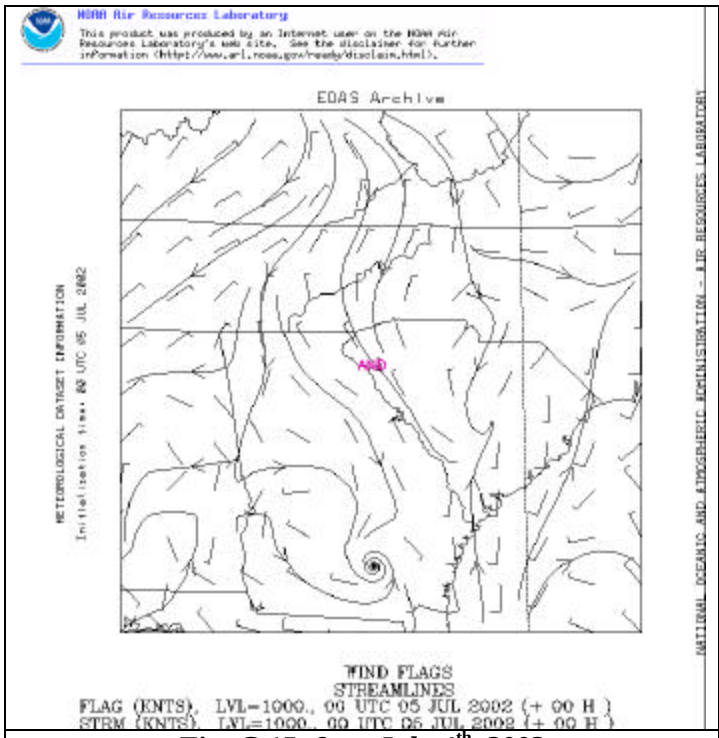


Fig. G-15: 8pm July 4th, 2002

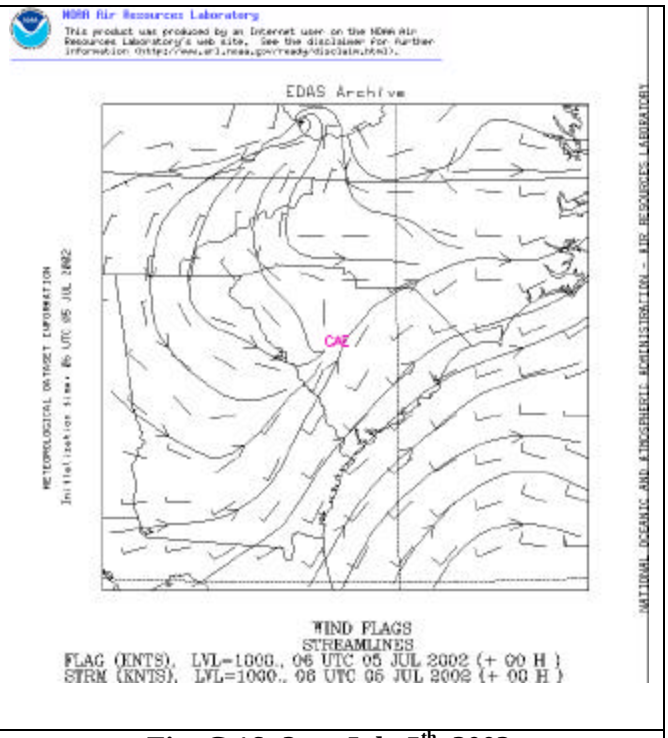


Fig. G-16: 2am July 5th, 2002

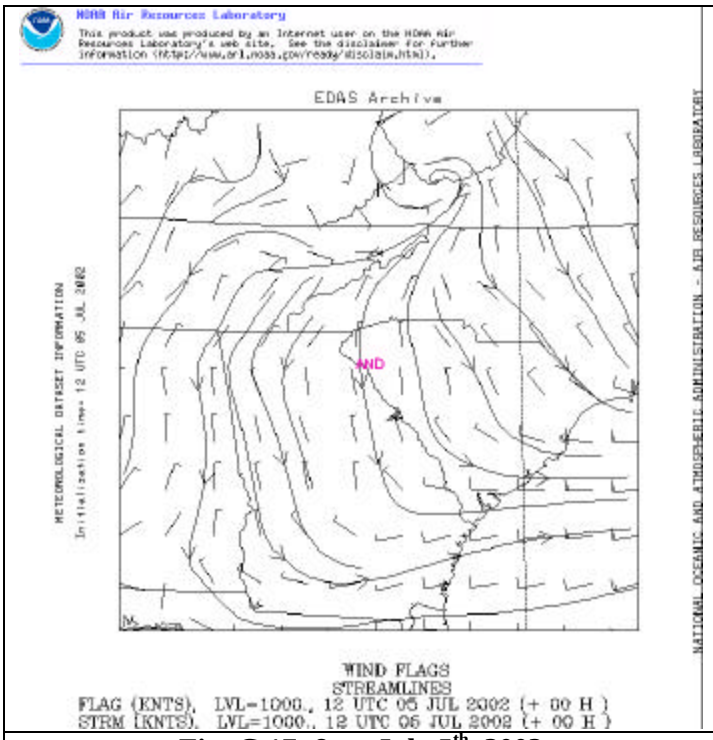


Fig. G-17: 8am July 5th, 2002

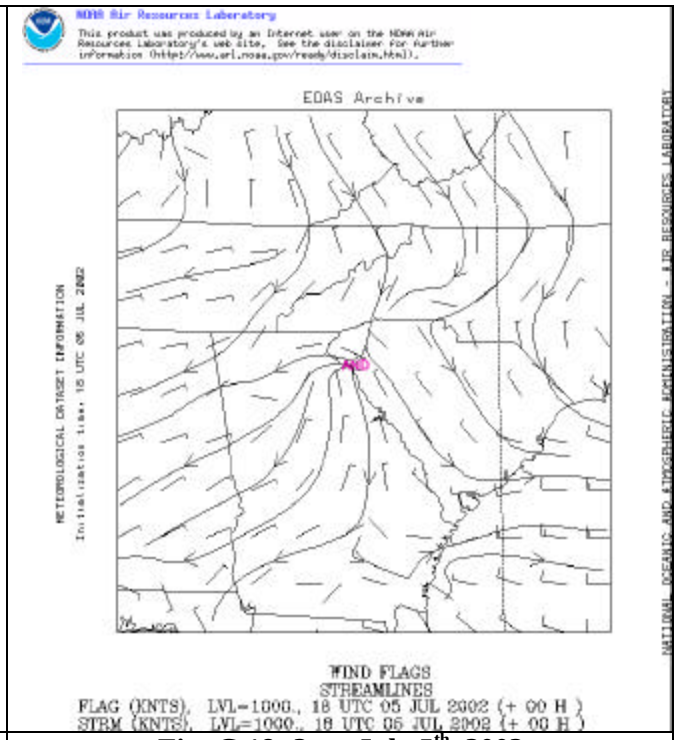


Fig. G-18: 2pm July 5th, 2002

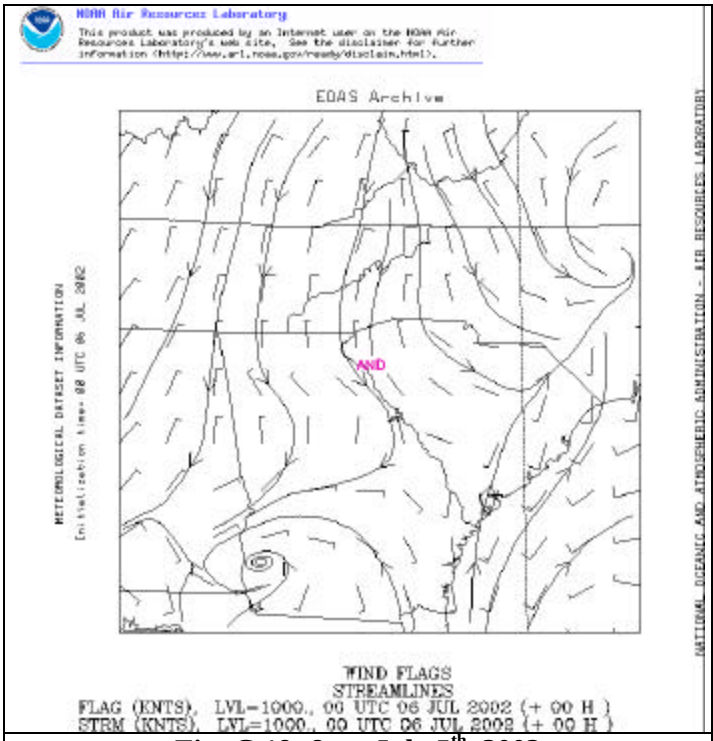


Fig. G-19: 8pm July 5th, 2002

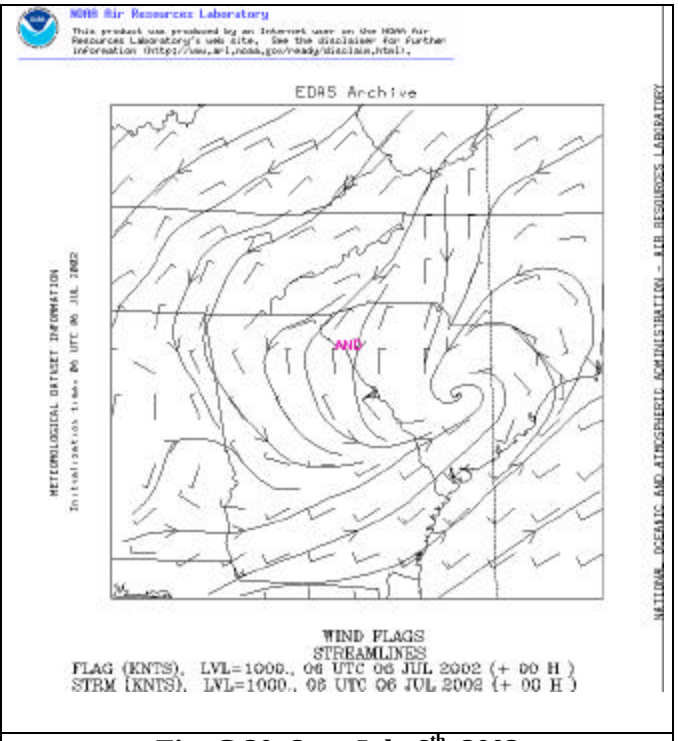


Fig. G-20: 2am July 6th, 2002

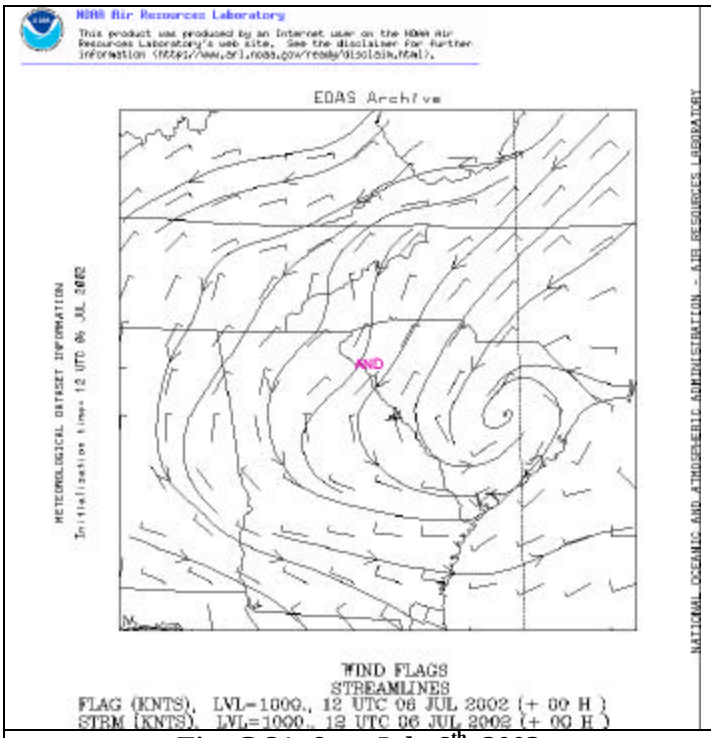


Fig. G-21: 8am July 6th, 2002

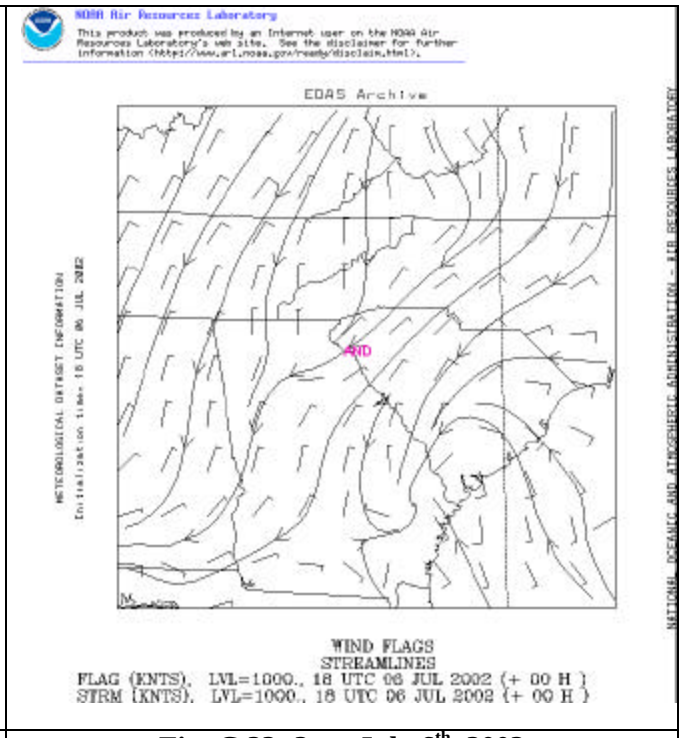


Fig. G-22: 2pm July 6th, 2002

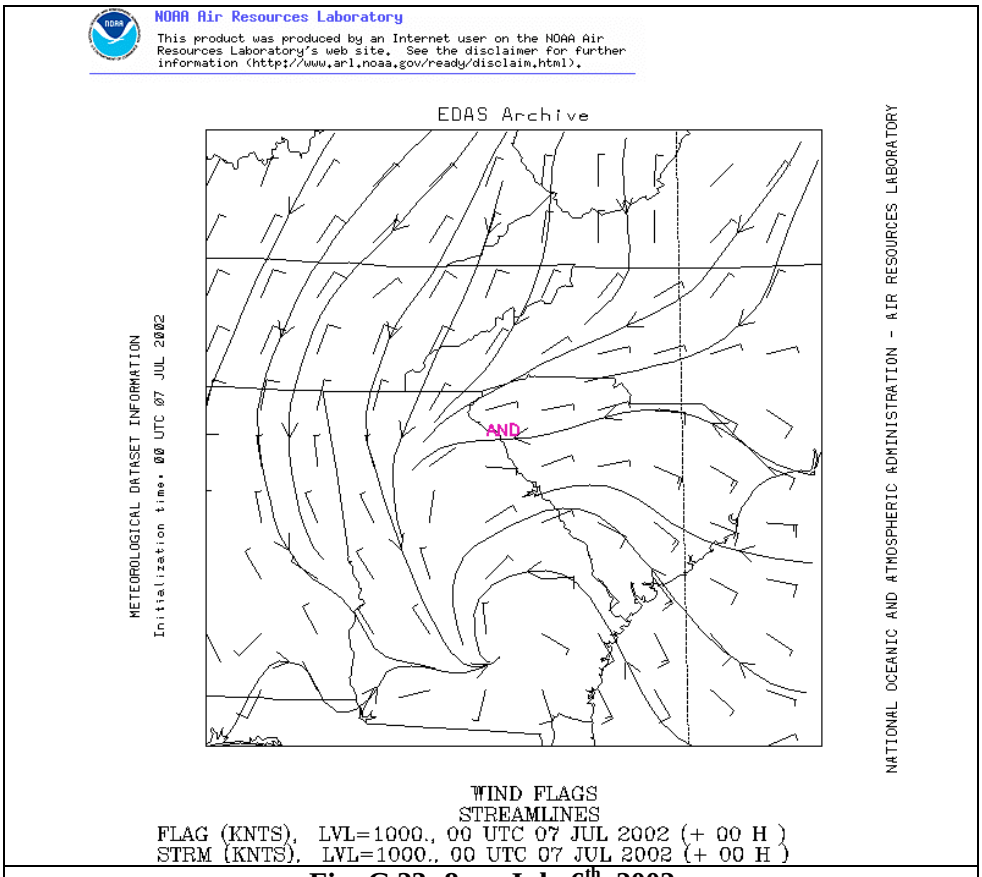


Fig. G-23: 8pm July 6th, 2002

Fig. G-24: 24-hr Back-trajectory, 8:00pm July 6th, 2002

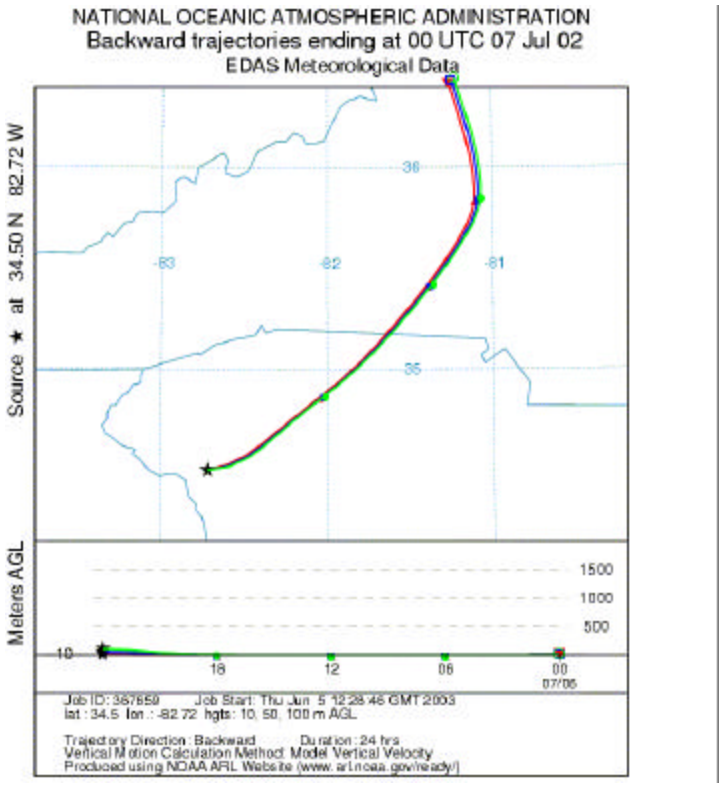
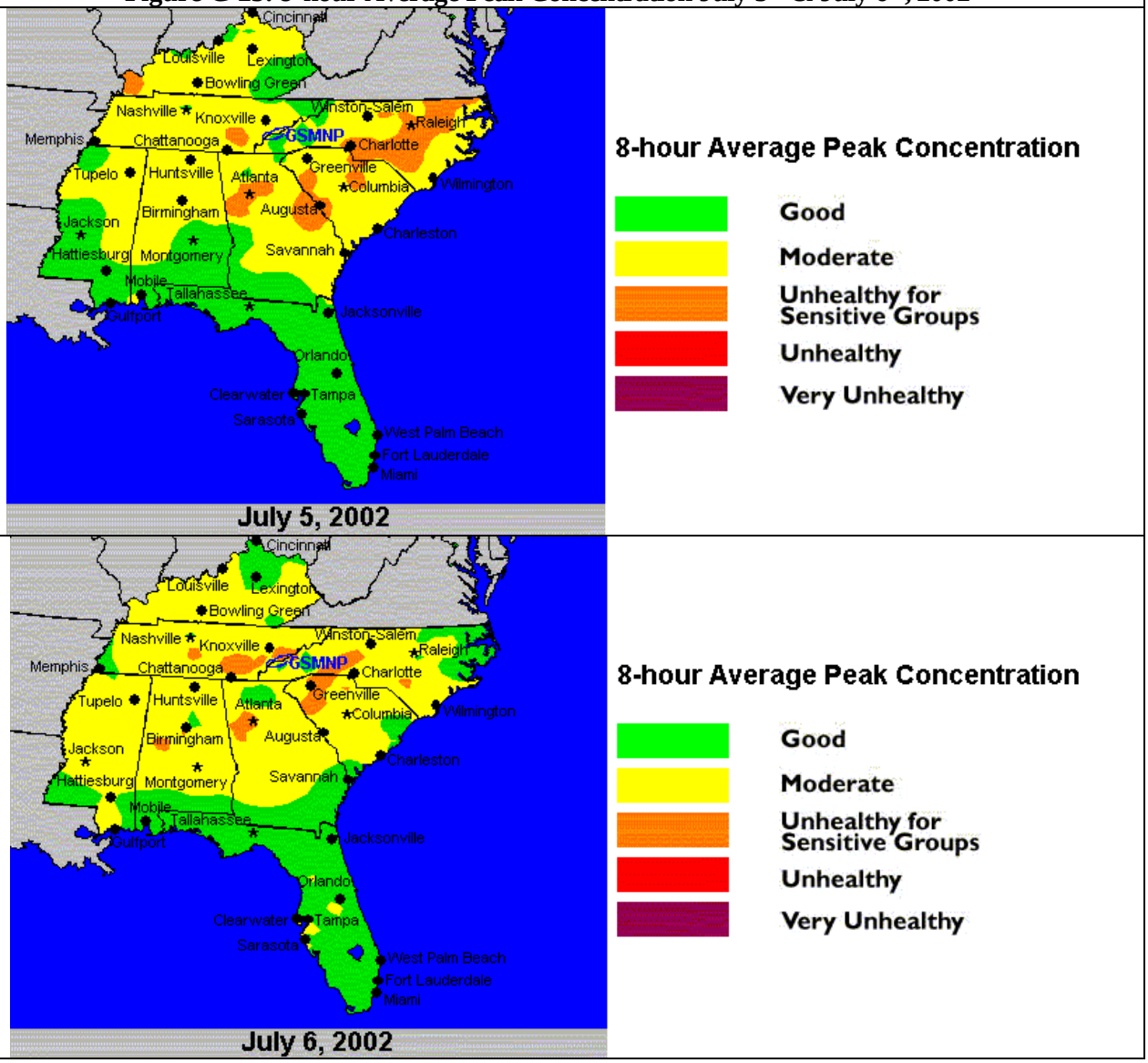


Figure G-25: 8-hour Average Peak Concentration July 5th & July 6th, 2002



IV. Summary

In summary, with native sourcing of NO_x and VOC from Abbeville County representing only 0.73% and 1.88% respectively of cumulative statewide releases, it is highly unlikely that emissions from this area alone can account for elevated ozone readings, especially "exceedence" events as evaluated above. All meteorological data reviewed clearly support upwind sourcing as the primary cause of elevated ozone measured at the Due West monitor, and the Department, as such, requests that the EPA treat Abbeville County as a "Rural Transport Area" in accordance with Section 182(h)(2) of the Clean Air Act.

H. Topography

See Section V - H of Introduction.

I. Jurisdictional Boundaries

The boundary of the Due West Monitoring Site Nonattainment Area is defined with the following description:

Starting point is in the town of Due West at the corner of Haynes Street (Mill Street) and College Street (SC 185 / SC 20).

Follows College Street (SC 185 / SC 20) southeast for 1.0 mile to Ellis Road (S-1-114).

Follows Ellis Road (SR-S-1-114) west then northwest for 0.8 miles. Ellis Road becomes Abbeville Street.

Follows Abbeville Street for 0.4 miles to Haynes Street.

Follows Haynes Street for 0.4 miles back to the starting point at College Street (SC 185 / SC 20).

J. Level of Control of Emission Sources

Through its participation with the Early Action Compact, Abbeville County is currently exploring local control strategies such as ozone awareness and education, open burning and mowing restrictions, and fuel efficient and low emission vehicles.

K. Regional Emissions Reductions

See Section V of the Introduction.